2041

Face and Body Selective Regions of the Marmoset Extrastriate Visual Cortex

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Purpose: The ventral temporal cortex of humans[1] and macaques[2] is marked by multiple, distinct regions of apparent specialization for the visual processing of faces and bodies. At present, the interspecies correspondence, or homology, of face- and body- selective patches in humans and macaques is a matter of speculation. Comparative data on this point are limited. Among Old World primates, face-selective responses have only been measured in macaques and humans, with few exceptions. Here we investigate face- and body-selective responses in the marmoset (*Callithrix jacchus*), a small, diurnal primate with a highly differentiated visual system whose areal homology to the macaque is well established[3].

Method: We trained four marmosets to direct their gaze toward presentations of faces, bodies and a variety of other objects and control images. Behavioral reinforcement for maintenance of gaze was achieved using liquid reward. In two of the animals (M1 and M2), we measured category-selective fMRI responses in a 7T horizontal scanner (Bruker AVANCE AVIII). Whole brain Blood oxygenation level-dependent (BOLD) responses were acquired at a spatial resolution of 0.5x0.5x1.0 mm. During each testing period, the animals were shown images of faces, bodies, objects, and several control patterns in a modified block design. In the other two animals (M3 and M4), we implanted pairs of 32-channel ECoG arrays (Neuronexus) in the occipitotemporal cortex based on the selective fMRI activity measured in M1 and M2. For both the fMRI and electrophysiological experiments, eye position was monitored and recorded using a video based eye-tracking system (MRC, ISCAN, and EyeLink).

Results: We identified five circumscribed cortical regions that responded significantly more strongly to faces than objects (t-test, $p<0.05$, corrected, **Figure 1**). These face patches were located area V3, the border between ventral portion of area V4 and TEO, area V4t and two distinct areas in TE separated by approximately 3 mm. Time courses derived from these patches revealed that the responses were graded across the different categories, with the specific ordering depending on the particular patch. Scrambled controls elicit lower responses compared to structured images in all patches. The anterior patches in TE showed a more exclusive face selectivity. Three additional body selective regions adjacent to the face patches are discovered by contrasting bodies to objects. Analyzing the energy increase in the high gamma band (50-150Hz), we found striking similar pattern of face and body selective pattern along the ventral stream (**Figure 2**). Moreover, we located another more ventral face selective site in TE that was not visible with fMRI due to signal drop out.

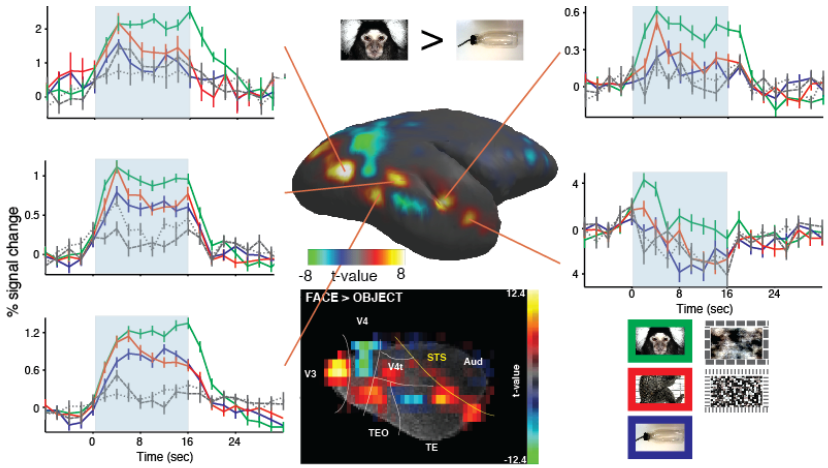

Figure 1. Face selective areas with time courses

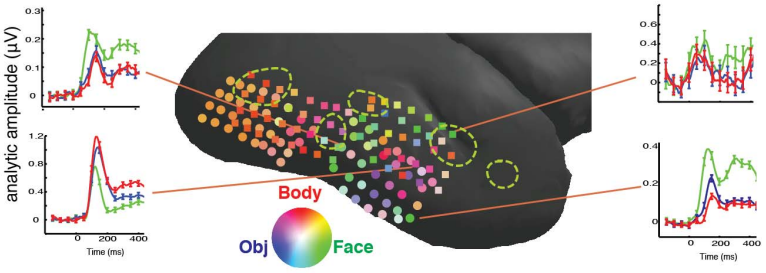

Figure 2. Face and body selectivity corroborated by electrophysiology

Conclusion: We reported six face-selective patches using fMRI and ECoG in the marmoset extrastriate visual cortex, with the most rostral patches in the STS and ventral TE regions showing the strongest bias for faces. The present results in a New World monkey suggest that key elements of ventral stream specialization for face and body processing were already present in a common anthropoid primate ancestor that lived at least 35 million years ago.

Reference: 1. N. Kanwisher et al., *Journal of Neuroscience* (1997), 4302-11
2. D. Y. Tsao et al., *Proceedings of the National Academy of Sciences* (2008),19514–19
3.M.G.P. Rosa et al., *Philos Trans R Soc Lond, B, Biol Sci* (2005), 665–91